

REMARKS

Claims 1-7 are pending. Claims 1-5 are rejected. Claims 6-7 are objected to. Applicants amend Claim 1 to recite “battery separator for an alkali secondary battery”, based on support in the specification, for example, in the bridging paragraph at pages 5-6. Claims 2-5 are also amended accordingly. Claim 6 is rewritten into independent form. Entry of the amendment is respectfully requested.

Reconsideration and review of the claims on the merits are respectfully requested.

Formal Matter

Applicants respectfully request that the Examiner acknowledge receipt and approve the formal drawings filed December 4, 2001.

Allowable Subject Matter

Applicants appreciate the Examiner’s indication that Claims 6 and 7 stand objected to as being dependent upon a rejected base claim, but would be allowable if written in independent form.

Applicants amend claim 6 into independent form. Claim 7 depends upon Claim 6. Accordingly, Applicants respectfully request allowance of at least Claims 6-7.

Prior Art Rejections Under 35 U.S.C. § 103

A. Claims 1 and 3-5 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Otani et al in view of Amano et al., and further in view of Nakamura et al. This rejection is maintained for the same reasons as set out from the previous Office Action.

The Examiner cites Otani as teaching a battery separator made of a polyethylene porous sheet. The Examiner admits that Otani does not teach the application of a polymer having repeating carbodiimide groups on the porous sheet.

The Examiner cites Amano as teaching the use of a pulp-like material which includes polycarbodiimide as a coating. The Examiner asserts that the material of Amano can be made into a sheet with excellent properties, including electrical insulation, heat resistance, flame resistance and mechanical properties, and is stated to be suitably used as a battery separator.

The Examiner concludes that it would have been obvious to one of ordinary skill in the art to apply a polycarbodiimide on the battery separator of Otani, because Amano teaches that polycarbodiimide has excellent electrical, thermal and mechanical properties.

The Examiner cites Nakamura as teaching a process for producing polyfunctional polycarbodiimide compounds where the molecular weight of the resulting compounds is about 1,000 to 30,000. The Examiner relies on this disclosure as allegedly suggesting the number of repeating units of the carbodiimide contained in the polymer of Applicants' Claim 1.

Applicants respond as follows.

Applicants amend Claims 1-5 to recite "battery separator for an alkali secondary battery".

The prior art does not suggest applying a polymer having repeating carbodiimide units as claimed to a porous sheet substrate to form a battery separator for an alkali secondary battery, much less suggest the advantages described in the present application. In particular, the results in the specification (see Table 1) demonstrate that when porous sheets formed from

polycarbodiimide-coated polymer particles having polycarbodiimide structural units are used as battery separators, then the self-discharge of the cells is considerably inhibited.

Amano uses a polycarbodiimide in the form of a flocculating agent for binding fine particles thereto. As a result, even if a sheet is prepared using fine particles and polycarbodiimide according to the method of Amano, it would be extremely difficult to control a pore size. Therefore, Applicants submit that one skilled in the art would also not be motivated to use a polycarbodiimide in a battery separator.

In the case that the effect of carbodiimide of Amano is applied to a separator of Otani and a polycarbodiimide is used expecting heat resistance, electrical insulation, dimensional stability and mechanical strength, properties of a separator are not improved unless the polycarbodiimide is greatly modified. The separator may clog, resulting in the decrease in properties of the battery. Therefore, one skilled in the art would not use a polycarbodiimide with the expectation of obtaining heat resistance, electrical insulation, dimensional stability and mechanical strength.

Nakamura expects the effect as an adhesive, a coating agent or an undercoat for coating or printing in a carbodiimide. However, similar to the case of Amano, the disclosure of Nakamura does not suggest to impart those effects to a separator, and furthermore does not suggest a separator with self-discharge for an alkali secondary battery.

Applicants submit that one skilled in the art would not predict the function of a polycarbodiimide skeleton in order to improve adverse properties of a self-discharge phenomenon in alkali secondary batteries. In fact, such a function is still not clarified at the

present time. The present invention is based on the effect found by screening various materials. Thus, the present invention is a great breakthrough and is patentable.

Further, Nakamura is directed to improvements in the fields of woven fabrics, paints, printing inks and the like (See Nakamura, col. 1, lines 38-39). Nakamura does not disclose, suggest or teach application of a polymer having a repeating carbodiimide unit for use in a battery separator for an alkali secondary battery.

Accordingly, Applicants respectfully request reconsideration and withdrawal of this rejection under 35 U.S.C. § 103(a).

B. Claims 1 and 2 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Kung in view of Amano and further in view of Nakamura. This rejection is also maintained for the same reasons as set out from the previous Office Action.

With respect to Claim 1, the Examiner cites Kung as teaching a battery separator formed of a microporous plastic sheet coated with a resin; the sheet is made of a non-woven fabric selected from the group consisting of polyolefin, polyamides and nylon fibers. However, as with Otani, the Examiner admits in the sentence bridging pages 3 and 4 of the Office Action comments, that Kung does not teach the application of a polymer having carbodiimide onto the porous sheet.

Applicants respond as follows.

As previously stated above, Claims 1-5 are amended. The same reasoning applied above applies to the present rejection. Neither Kung, Amano, nor Nakamura discloses, suggests or

teaches, individually or in combination thereof, application of a polymer having a repeating carbodiimide unit for use in a battery separator for an alkali secondary battery.

Amano and Nakamura are applied in the same fashion as set forth in the Otani-based rejection above. The issues for traversal on the merits are similar to those discussed above in the Otani-based rejection.

As noted above, Amano uses a polycarbodiimide in the form of a flocculating agent for binding fine particles thereto. As a result, even if a sheet is prepared using fine particles and polycarbodiimide according to the method of Amano, it would be extremely difficult to control a pore size. Therefore, Applicants submit that one skilled in the art would also not be motivated to use a polycarbodiimide in a battery separator.

In the case that the effect of carbodiimide of Amano is applied to a separator of Kung and a polycarbodiimide is used expecting heat resistance, electrical insulation, dimensional stability and mechanical strength, properties of a separator are not improved unless the polycarbodiimide is greatly modified. The separator may clog, resulting in the decrease in properties of the battery. Therefore, one skilled in the art would not use a polycarbodiimide with the expectation of obtaining heat resistance, electrical insulation, dimensional stability and mechanical strength.

Nakamura expects the effect as an adhesive, a coating agent or an undercoat for coating or printing in a carbodiimide. However, similar to the case of Amano, the disclosure of Nakamura does not suggest to impart those effects to a separator, and furthermore does not suggest a separator with self-discharge for an alkali secondary battery.

AMENDMENT UNDER 37 C.F.R. § 1.116

U.S. Application No. 09/980,496

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Applicants submit that one skilled in the art would not predict the function of a polycarbodiimide skeleton in order to improve adverse properties of a self-discharge phenomenon in alkali secondary batteries. In fact, such a function is still not clarified at the present time. The present invention is based on the effect found by screening various materials. Thus, the present invention is a great breakthrough and is patentable.

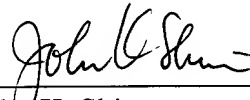
Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. § 103(a).

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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